SYNOPSIS REPORT

OF THE

NATURAL FIBER PROPERTIES WORKSHOP

SPONSORED BY

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SCIENCE AND EDUCATION ADMINISTRATION

HELD AT

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SUMMARY AND RECOMMENDATIONS

Coordinated by Mr. Nelson F. Getchell, National Research Program Leader for Processing Technology - Fiber Uses, a Workshop was held in Charlotte, North Carolina, on March 11, 12, and 13, 1981, to identify and define research requirements to assure that technology needed in the future to measure important fiber properties for marketing cotton, wool, and mohair will be available. The Workshop was planned assuming universal agreement that agricultural products such as the natural fibers, cotton, wool, and mohair require extensive processing to render them suitable for consumer use and that the simple description "cotton" or "wool", or "mohair" is not adequate for marketing and utilization. A description of the fibers in terms of their properties is necessary to determine their potential value and efficient end use. This requirement for extensive post-harvest processing before utilization by the consumer is a distinguishing characteristic of the natural fibers and separates them from other agricultural commodities such as wheat, corn, soybeans, meat, etc. which require relatively little post-harvest processing prior to utilization.

During the past few years there has been significant technological progress in electronics, laser optics, analytical instrumentation and many other specific branches of science and technology. In several cases it has been possible to apply concepts and technology from these special areas to fiber science, but for the most part, fiber property measurement technology in current use is based upon fundamental fiber property research of the 1950's. The knowledge accumulated from this fundamental work is being used up at a faster rate than it is being replenished. The research program to maintain this knowledge base has gradually diminished. Because of conflicting demands for work in many other areas and budget and personnel limitations,

the Department of Agriculture, long a leader in natural fiber property research, has not had adequate resources to maintain a viable research program on basic natural fiber property measurement. To help determine the desirability for revitalizing research and to help clarify and give direction on future needs, knowledgeable representatives from the textile industry, fiber associations, research and academic institutions, and fiber testing instrument manufacturers were invited to participate in Workshop discussions on natural fiber property measurements.

Participants in the Workshop were requested to address their thoughts and discussion to a list of seven key questions:

1. Prior to committing natural fibers to specific end products, is it necessary for the textile manufacturer to validate the quality designations assigned the fibers by the supplier?
2. Prior to committing natural fibers to specific end products, is it necessary for the textile manufacturer to measure other quality factors than those furnished by the supplier?
3. Assuming the answers to 1 and 2 are affirmative, is it desirable for the supplier to provide the manufacturer with complete and reliable quality information so that additional testing is not necessary?
4. If the manufacturer had data available on fiber quality using testing procedures currently known and adaptable for high volume testing, would this data meet all required quality information needs?
5. Are there fiber property measurements used traditionally in industry that are no longer useful?
6. Using current technology are the methods suitable for high volume testing accurate and reliable enough to meet manufacturer's needs?
7. Is there a need for research to explain the importance of fiber properties

other than those traditionally used and is there a need for development of methods and procedures to measure and utilize those properties?

To facilitate discussion the subject for each session was narrowly defined as outlined in the Agenda. Discussion leaders quickly summarized the state of the art in each subject area and monitored ensuing discussion by participants to assure that each subject was thoroughly discussed and that a reasonable concensus on recommendations was obtained. Notes were taken by participants and integrated into a synopsis report. A summary of the concensus recommendations on research needs for each subject area is included in the following outline:

Sampling - Cotton:

1. Develop a method for rapidly sampling cotton bales to provide a uniform, representative sample for high volume instrument testing (high priority).
2. Develop method for uniform specimen preparation (high priority).

In anticipation of continued expanded use of modules in harvesting and the implementation of a user fee system for cotton classification:

3. Study the feasibility of statistical sampling to characterize multiple bale lots of cotton.
4. Expand the research effort on on-line measurements to provide fiber property measurements concurrently with ginning.
5. Study the feasibility of seed cotton sampling for fiber property measurements.

Sampling - Wool:

No recommendations.

Length and Length Uniformity - Cotton:

1. Study methods for rapid measurement of short fiber content and its relationship to processing quality.

2. More generally, develop a method for measuring and interpreting fiber length frequency distribution to provide complete length information for users (users could choose length parameters important to them).

Length and Length Uniformity - Wool:

1. No apparent need now for research on length measurement in wool. A low priority need might be to study how crimp affects wool length measurements.

Strength - Cotton and Wool:

1. Determine the usefulness of tensile measurements of cotton and wool fiber bundles. Current instrument technology appears adequate. Specimen preparation improvement should improve tensile measurement variability.
2. Develop method of measuring the strength and strength variability of individual cotton and wool fibers.
3. Determine if single fiber strength measurements are more useful than bundle measurements.

Fineness and Maturity - Cotton:

1. Reduce the variability of fineness measurements with airflow or other instruments.
2. Define the meaning and usefulness of maturity measurements and how they relate to fineness.
3. Determine the usefulness of single fiber fineness and variability measurements.

Fineness - Wool:

1. Improve microprojection technique for measuring fineness.
2. Develop a rapid, low-cost method for measuring fineness and fineness variability.

Reflectance Measurements - Cotton:

1. Develop method for using reflectance measurements, visible, UV, IR, etc., to correct color measurements for contaminants such as trash, excessive plant residues, oil, etc. and to sharply define off colors such as light spotted cotton. (See Yield Measurements.)
2. Study feasibility of using reflectance measurements for an objective evaluation of "preparation."

Yield Measurements - Cotton:

1. Develop a rapid method for determining trash content.
2. Develop a rapid method for identifying trash components.
3. Detect and measure contaminants such as excessive sugars, oils, and other substances affecting processing quality.

Yield Measurements - Wool:

1. Develop a rapid, low-cost method for measuring yield and vegetable matter.

Other Fiber Property Measurements - Cotton and Wool:

1. Determine the usefulness of "other fiber properties" such as elongation, toughness, resilience, etc. as indicators of fiber or end use quality.
2. Study methods of combining fiber property measurements into indexes to reduce the number of catagories necessary for efficient marketing and utilization.

ORIENTATION

The value of agricultural products is largely determined by their performance when utilized or consumed. The United States Department of Agriculture (USDA) has established programs to assure communication between the buyer and seller concerning measurements used in marketing agricultural products. It is essential for producers to know the market value of their products to assure effective and efficient marketing. An understanding of the properties that determine market value allows producers to develop production practices that maintain and improve market quality and value.

Two objectives of programs of the Department of Agriculture are to identify and quantify characteristics which determine or relate to performance and to establish a common language for communication between the buyer and seller of agricultural products. For cotton, wool, and mohair, the Department of Agriculture conducts studies to identify fiber properties that determine processibility and performance and to develop improved methods and procedures for measurement of these properties. The Department of Agriculture also establishes and maintains standards for comparison of fiber properties and performs tests on samples to provide the producer with a measure of the important properties of his products.

The Department of Agriculture, with the cooperation and assistance of the cotton and wool industries, the textile industry, and others, has undertaken a program to identify future needs for measurements and measurement systems to evaluate the market value properties of natural fibers. A specific objective of the program, of which this report is a part, is to identify the future needs of producers and users of natural fibers for methods, procedures and instruments to measure the properties of fibers in order to assure an efficient and reliable marketing system.

INTRODUCTION AND OBJECTIVES

The "Natural Fiber Properties Workshop," sponsored by the United States Department of Agriculture, Science and Education Administration, was held in Charlotte, North Carolina, on March 11, 12, and 13, 1981. Its program was coordinated by Mr. Nelson F. Getchell, National Research Program Leader for Processing Technology for Fiber Uses, Science and Education Administration. The approximately forty participants contributing to the technical program were from the United States Department of Agriculture, Science and Education Administration and Agricultural Marketing Service, the United States Department of Treasury, Customs Service, leading fiber industry associations, including Cotton Incorporated, National Cotton Council, and the Wool Bureau, companies engaged in the production, marketing, and textile processing of cotton and wool, and companies engaged in the development, manufacture, and sale of instruments to measure fiber properties. Academic research leaders also participated.

The program of the Workshop focused on future requirements for measurement of the market value properties of cotton, wool, and mohair. The objective of the Workshop was to identify needed research to assure that technology is available in the future to perform these measurements. A secondary objective was to provide guidance for planning current and future research programs to incorporate new or refined technology for identification, measurement, and classification of fiber properties and characteristics.

Many of the improved instruments and measurement procedures currently being considered for adoption as part of the fiber marketing system represent technological advances derived from basic research conducted in the 1950's and

early 1960's. Discussions and analyses associated with this Workshop should assist in identifying priorities for basic and applied research programs currently needed to assure that the technology requirements of the future will be met. Cotton and wool and mohair fibers have similar requirements for property measurement and evaluation. The principles, and to some extent the instrumentation, involved in objective measurement of fiber properties are common to both fiber groups. One purpose for including in a single program discussions by knowledgeable scientists and marketing experts from both fiber groups was to stimulate cross-fertilization of ideas to lead to improved technologies for each.

NEEDS FOR FIBER PROPERTY MEASUREMENT

The marketing of cotton, wool, and mohair is based upon a system that determines value from the measurement of certain fiber properties or characteristics. For the purpose of commerce, the properties agreed upon as indicators of market value are measured relative to standards established and maintained by the United States Department of Agriculture. The Department of Agriculture also maintains laboratories that perform these tests on samples supplied by producers. The Department has an extensive cotton classing program which includes classification of the properties of samples from a vast majority of the bales of cotton produced in this country each year. Commercial laboratories, as well as the laboratories of large cotton producers and producer cooperatives, also measure and report the properties of samples.

For wool and mohair the Department of Agriculture classification program is limited primarily to the maintenance of standards. However, commercial testing laboratories test samples of wool or mohair to evaluate their properties for the buyer or the seller. The United States Treasury Department maintains a laboratory and testing program to evaluate the properties of imported wool.

So there exists today, and has existed for many years, an extensive fiber property testing program for the natural fibers. The market value of fiber is established based upon the results of these tests. Therefore, it is of immediate concern to evaluate whether or not the current classification system provides an adequate measure of all the important properties that establish market value and whether or not the values of these properties are reported with sufficient precision and reliability to meet the needs of the producer or buyer.

Currently, cotton market value is based upon two different sets of property measures. One is the traditional set, classifying cotton by its staple (length), grade (color, trash and preparation), and micronaire (fineness). The measure of staple and grade is determined by physical examination made by a highly trained cotton classer, while micronaire is measured by an instrument.

The market value of cotton may also be based on a second set of property measurements that are almost all made by instruments. The Department of Agriculture has established an experimental program for these instrument measurements and has termed this test procedure the High Volume Instrument (HVI) procedure. The HVI procedure provides a greater number of different measurements than is provided by a cotton classer. However, the instruments do not necessarily measure the same characteristics that the classer measures and the results of the two systems, although related, are not directly comparable. The HVI system is currently capable of measuring several properties including length distribution, strength, elongation, micronaire, color, and trash content. Traditionally, each bale of cotton is sampled and the fiber properties for each bale are measured from standard classer's samples.

HVI measurements currently reported include upper half mean length and the ratio of mean length to upper half mean length as determined from length distribution measurements, strength, micronaire, color, and trash content. No data on elongation are currently reported and the trash content is determined by a technician by visual comparisons with standards.

For wool and mohair, the most important fiber properties measured to assess market value are fiber fineness and yield (fiber weight corrected for oil and vegetable-matter content.) Average values of these properties or characteristics

are assessed by using laboratory analysis procedures on a composite sample representing a number of different bundles or bales of fiber.

Thus, the marketing systems for both cotton and wool include the assessment of similar fiber properties or characteristics. Testing facilities of impartial laboratories are available to both the buyer and seller, as well as to the user.

In general, a marketing system works best if the producer, buyer, and user are all able to communicate the properties or characteristics of importance to them. Several basic questions address the ability of the textile industry currently to utilize the available quality information for marketing. These basic questions are outlined below. Some brief observations concerning these questions are also included, although definite, simple answers are not possible. The issues raised by these questions are discussed in greater depth in later sections of this report.

Question 1. Does the textile manufacturer find it necessary to repeat the fiber quality measurements assigned by his suppliers prior to committing his raw fiber to a specific mix? For cotton and for wool, the answer to this question appears to be yes. Two sets of quality factors are, or could be, presently available from the supplier, the grade-staple classification and the HVI system test results. Both of these sets of quality factors are of value to the textile manufacturer. The HVI system provides much more directly usable information than the grade-staple system. For wool, the supplier's assessment of fineness, yield, and vegetable matter is useful to the textile manufacturer. For both cotton and wool, the fiber property information provided by the supplier is of value, but is not sufficient, as is discussed with reference to the next question.

<u>Question 2</u>. Does the manufacturer find it necessary to determine quality factors in addition to those furnished by the supplier prior to committing his raw fiber to a specific mix? For cotton and for wool, the answer to this question is yes; additional quality information is required. Textile Manufacturers find it necessary to measure additional properties not provided by the supplier. To this extent, there is not complete communication between the producer and the user concerning the relative value of certain characteristics to the user.

<u>Question 3</u>. Would it be desirable for the supplier to be able to provide the manufacturer with complete and reliable quality information so that no additional testing is necessary? For cotton, it appears desirable for the supplier to provide more information, and more reliable information, than is presently being provided. The information provided by the HVI system for characterizing cotton market value includes measures of fiber properties that are of considerable importance to textile manufacturers. Most textile manufacturers presently measure some of the properties that are included in the HVI system. The HVI system includes measures of a greater number of properties than are generally needed to form a mix for a specific product. Properties commonly of importance appear to be length, fineness, color and strength; however, other properties are important in specific situations. Certain properties are important for a particular product but not generally important for all products. It is not practical to expect the supplier to be able to provide a measure of all the properties that might be important for all products. However, the marketing system would be more efficient if measurements of the properties that are most frequently used could be provided reliably by the supplier.

Information is required on a larger number of important properties for wool than for cotton in order to develop a mix for a specific product. Fiber requirements for different wool products tend to vary greatly from product to product. It does not appear practical for the wool supplier to provide all of the property information that may be important for a particular product or even for a group of products. However, some properties are of frequent importance, and information on them provided by the supplier would make the marketing system more efficient. Specific properties that might be considered are discussed in later sections of this report.

Question 4. Does the quality data provided by the High Volume Instrument (HVI) classification system meet the manufacturer's quality information needs? In general, it appears that the answer to this question is that the HVI measurements do meet most of the information needs. The properties measured by the HVI system include those most frequently required for cotton textile manufacturing. Suggestions for new property measurements that might be included as part of the marketing system are discussed in later sections of this report.

Question 5. Are there any fiber measurements in the HVI system that are not needed by the textile manufacturer? The answer to this question is not clear. There are some measurements in the HVI system that are not as frequently used by some textile manufacturers as by others but are of value for certain products. Not enough information is available to conduct a cost-benefit analysis to determine whether the less frequently used property measurements are of sufficient value to justify providing them. However, it has been determined that the least used measurements are also the least expensive to measure.

Question 6. Are the current HVI measurements accurate enough or reliable enough for textile manufacturers' needs? The answer, with regard to accuracy, is not clear. For many textile products there is a need for greater precision in specification of fiber length than is available. The adequacy of the precision of measurement of the various HVI system measurements is discussed individually in later sections of this report. The answer concerning reliability appears to be that there is a need for improvement.

Question 7. Does the manufacturer need quality information that the HVI system does not provide and are there obvious areas where there is a need for research and development of new methods for providing it? The answer to this question appears to be definitely yes. Recommended areas for research on specific fiber properties are outlined in later sections of this report.

COTTON SAMPLING

The reliability of the evaluation of a product is not better than the reliability of the sample. In the case of cotton, a sample from a bale is tested and the properties of the sample are assumed to be those of the entire bale. The sample, the portion of the bale which is brought to the testing laboratory for evaluation, is usually less than 1/1000th of the bale. The amount of fiber actually tested, the specimen, is usually less than 1/100,000th of the bale when measuring micronaire and 1/1,000,000th of the bale when measuring length.

Typically, the sample of fibers to be tested is obtained by cutting fibers from each side of a bale of cotton after it has been ginned and baled and the bale assigned an identification number. There are disadvantages associated with this method of sample collection. One disadvantage is that sections cut out of the side of the bale leave holes in the bale wrappings exposing fibers to damage during handling or storage. A second disadvantage of this sampling procedure is that it can result in contamination of the remaining cotton with the cut polypropylene bale wrapping. An advantage of this method of sample collection is that there is a minimal chance of error in reliably identifying the samples with the bale which they represent. Usually, samples are cut from two sides of the bale for classification. The USDA classing office classifies the samples from each side separately. If the two samples are judged to be two or more grades different from each other, the bale receives the special identification of "two-sided bale." If the two sides are judged to be one grade apart, the bale is assigned the lower grade of the two. The number of bales classified as being "two-sided" is very

small and is probably not sufficient to justify taking two samples. A number of the Workshop participants expressed personal opinions (or referred to confirming studies) that bales could be almost as reliably classed using one sample as using two samples. There seemed to be considerable opinion that it would be cost-effective for USDA to change its procedures to utilize only one sample. However, the observation was made that perhaps if ginners knew that only one side of the bale was to be sampled, some might be tempted to try to take commercial advantage by deliberately producing two-sided bales. No further research on sample uniformity for traditional cotton classification seems to be necessary. It might, however, be informative to conduct an analysis of the cost-benefit of taking one versus two samples per bale.

A number of years ago a sampling device was developed that automatically collects a sample of the cotton in the gin as the bale is being formed. This automatic sampler has not been widely adopted. There was a time when it was believed that cotton classers might tend to grade the samples gathered by the automatic sampler lower than samples gathered in the traditional way because of their different appearance. Studies by the USDA have since shown no significant difference in the grades assigned to either type sample. A disadvantage of the automatic sampler is its cost (approximately $16,400 per bale press installed), an expense that could be significant for small gins. Workshop participants could not seem to identify any specific deficiency of the existing automatic sampling device or any deficiency in the practice of sampling as the bale is formed that would alone explain the reluctance of the cotton industry to adopt this method of sampling.

It was pointed out that the traditional sample size, preparation, and handling have all been guided by an incentive to present a normal or

good-looking sample to the cotton classer so he would not be negatively influenced by appearance factors not associated with actual fiber properties. If testing procedures become instrument based rather than based upon human judgments, the ideal size, shape, and configuration of the sample may change. For instance, it may be advantageous to blend samples mechanically before classing. Some of the Workshop participants recommended that further research be conducted to determine optimum sample size and characteristics for reliable and minimal cost testing using an instrument line such as the HVI system.

It is now typical to class each bale of cotton individually. In some areas of the country an individual lot of cotton may contain many bales but the variation in fiber properties among bales may not be significant. In order to characterize the market value properties of the lot, it may not be necessary to test each bale individually, but only a representative number of bales. Considerable savings in the cost of classing could be achieved by not measuring more bales from a particular lot than is necessary. A number of Workshop participants recommended that research be conducted to establish guidelines for the most cost-effective number of bales to be classed for cottons grown and ginned under uniform conditions. A consideration that should be kept in focus, however, is that the textile mill in forming a fiber mix must usually select the bales individually. Therefore, it is usual for the textile mill to obtain a measure of certain fiber properties for each individual bale.

WOOL SAMPLING

Different criteria apply in the sampling of wool than in the sampling of cotton. There is usually much more variability within a bale or bag of wool than within a bale of cotton. The variability within an individual wool lot is so large that textile manufacturers generally cannot select wool for a particular product mix based upon one or two small hand samples from an unknown lot.

In order to assess the commercial value of a lot of wool, core samples are taken from a number but not necessarily all of the bales or bags in the lot. A particular lot of wool may consist of a few bags or more than a hundred bales. Forty to eighty core samples are usually sufficient to obtain a characteristic sample for testing.

Core samples are obtained from a lot of wool using a cylindrical drill type apparatus that cuts out a small cylindrical plug. Cores are taken from different bales or bags in the lot. The cores are then blended and a subsample of fibers selected from this composite sample for testing.

The sampling and testing of wool imported into this country is conducted by the Treasury Department which estimates the commercial value of the wool in order to assess the import duty. Domestic wool and some types of imported wool are not tested by either the Treasury Department or by the Department of Agriculture. Wool producers and buyers use commercial laboratories to measure value characteristics on a fee basis. The cost to sample and evaluate a lot of wool can range from $100 to $200 per lot. Most domestic wool is sampled and tested to determine fineness, yield, and vegetable matter content. However,

quite often wool and mohair are not tested while owned by the producer. Rather, much of the domestic wool and mohair is sold by the producer based upon subjective assessment of its properties and testing is performed at a later time.

Participants in the Workshop discussed a number of limitations of the currently used methods for sampling wool. However, there were no recommendations for research to improve wool sampling. Participants in the conference pointed out that for many properties of wool important to a specific end product, present instrument testing techniques cannot provide an evaluation as useful as the subjective evaluation of an experienced wool buyer. However, it was noted that experienced wool graders are becoming harder to find.

Australia appears to be the world leader in developing a marketing system for wool based upon quantitative assessment of fiber properties. The Australian marketing system utilizes core-sample results and "display" samples that consist of several pounds of fiber selected from the lot being evaluated.

Extensive research on wool sampling as well as wool testing is currently being conducted in Australia, New Zealand, and South Africa. A valuable reference article reviewing the objectives of the Australian program is "New Objective Measurements for Wool," Rural Research (A CSIRO Quarterly Publication), No. 106, March 1980.

COTTON LENGTH AND LENGTH UNIFORMITY

Any randomly selected sample of cotton contains fibers of many different lengths. The fiber length distribution of a sample is probably the most important single parameter for determining the market value of the lot of fibers that the sample represents.

For many years the characteristic length of the fibers in a sample has been assessed by a cotton classer as part of the classing system provided by USDA. The cotton classer selects a small tuft of fibers from a sample, manually forms a beard, and assesses the characteristic length to the nearest thirty-second of an inch. Today, most cotton is marketed based upon this subjectively determined assessment of fiber length although many textile manufacturers determine the components of a particular mix from instrument measurements of fiber length.

Instruments are available and widely used today to measure fiber length characteristics. Instrument measurements are based on a fibrogram of a beard of the fibers. Fibrogram is the name given the relationship of the "amount" of fiber in a beard of fibers to the length along the beard. Fiber length characteristics are determined by measuring certain parameters of the fibrogram.

Basic research in the 1940's and 1950's by Hertel and others led to the development of the length measurement procedure for determining fiber length based on the parameters of the fibrogram. A fibrogram is obtained by forming a beard of fibers and measuring the amount of fiber at various cross sections along the length of the beard. A beard of fibers is formed by grasping a fiber specimen in a clamp and combing or brushing away all of the fibers that protrude from the clamp but are not held by the clamp, leaving a tapered beard

of fibers. Each fiber is grasped somewhere along its length by the clamp with one end of the fiber extending out of the clamp and contributing to the formation of the beard. Physical measurements are made of the amount of fiber in various cross sections of the beard at different lengths from the clamp to develop the relationship of amount versus distance from the clamp. The parameters of this relationship are then measured. One useful parameter for evaluating the length of the fibers in the sample is the span length. The span length is the length of the fiber beard or the length from the clamp where the beard has thinned to a certain percentage of the amount at the clamp. Two commonly used parameters are the 50% and the 2.5% span length, the length of the fiber beard when the cross sectional amount is reduced to 50% and 2.5% of the initial amount. Another valuable parameter is the uniformity ratio, the ratio of these two parameters. Other parameters often used to determine a fibrogram are approximations of mean length based on the projection of a tangent to the fibrogram curve to the length axis. Two commonly used parameters are the mean length and upper-half mean length.

Two instrument companies, Spinlab, Inc. and Motion Control, Inc., have developed the instruments generally used to measure fiber length. The Spinlab instrument uses a light beam projected through the fiber beard to assess the amount of fiber in the cross section of the beard. The Motion Control instrument utilizes an airflow principle for measuring beard cross-section. The pressure drop is measured across a slotted orifice in which the beard has been inserted. The cross section being measured partially blocks the throat of the orifice effecting a pressure drop in proportion to the amount of fiber in the cross section.

The output of the sensing heads of either of these instruments is an electrical signal. Since the advent of low-cost digitizing and computation devices, it is easily possible to measure and store the entire fibrogram measured by the instrument and to program the instrument to provide the user with the desired parameters for a specific application. Although the test results from the instruments manufactured by the two companies are quite similar, the results from one cannot be directly converted analytically to match the results of the other because of different effects characteristic of the clamping mechanisms used, the beard cross-section sensing device, and other basic design parameters. The correlation between test results on the two instruments has been found to be 0.92 or better.

Both of these instruments, as well as the human-based classing procedure, have been successfully used for many years throughout the cotton marketing and textile manufacturing industries to provide an assessment of the relative length properties of various cotton samples. The measurement precision of the instruments has been extensively studied. It has been found that a cotton classer will repeat his originally assigned designation of mean staple length within the tolerances listed below:

Maximum difference in assessed length (inches)	Percentage repeatability when retested
None	29%
± 1/32 (.03125)	71
± 2/32 (.0625)	90
± 3/32 (.09375)	97
± 4/32 (.1250)	100

This degree of precision of measurement is not adequate for the textile

manufacturer in selection of bales to form a fiber mix. Although the classer-assigned length has been used for assessing the market value of cotton for many years, it is currently recognized that length measurements of greater precision are of sufficient value to justify the cost. The USDA HVI instrument system includes instrument measurement of fiber length and length uniformity. The percentage of the time the HVI system will yield repeat results within the tolerances indicated is as follows:

Maximum difference in assessed length (inches)	Percentage repeatability when retested
None	21%
± 1/100 (.0100)	46
± 2/100 (.0200)	78
± 3/100 (.0300)	93
± 4/100 (.0400)	98

The major source of variability in length tests on the HVI system is in the clamping and preparation of the fiber beard. The instrument repeats measurement almost exactly when remeasuring the same fiber beard. There seems to be a need for further research on improved techniques for obtaining a characteristic sample and for preparing the beard for measurement.

Textile manufacturers routinely select bales of cotton for a product mix from instrument measurement of fiber length, and some consider the length uniformity parameter as well. Generally, textile manufacturers believe they must now remeasure samples from each bale because they lack confidence in the length measurements provided by the supplier. There is considerable interest in purchasing cotton based on instrument measurement of length; and some textile manufacturers are currently purchasing cotton on this basis. In order for the

textile industry to accept the instrument assessment of length provided by the supplier, reliability of the information supplied must be improved. Credibility of data provided by the supplier is a major textile industry concern. There is widespread belief that the quality data provided by the supplier contain an unacceptable level of errors. Another industry concern in accepting the measurements provided by the supplier, as obtained from the HVI system, is that the precision of these measurements is sometimes not high enough for forming certain product mixes. There is a need for research to develop improved procedures or methods for sampling and preparing fiber specimens for greater precision in length testing.

The textile industry does not currently use information on length uniformity to any great extent. Since information on this property can be obtained at almost no extra cost when making a measurement of length using the modern length measurement instruments, it is generally available both from the supplier and from the mills' own length measuring program. Because the available information is not being extensively used, the Workshop participants expressed very little demand for increased research and development on length variability measurement.

Another important length parameter is the measurement of short fiber content. Since short fibers affect ring spinning more than open-end spinning, the measurement of short fiber content may be increasingly important as open-end spinning becomes more popular and the fiber market becomes more specialized. The Workshop participants appeared to recommend quite strongly a research and development program to establish a method for measuring short fiber content as part of the market property measuring system. Since short fiber content measurements are inherent in fiber length variability measurements, the Workshop participants were inconsistent on this matter.

WOOL FIBER LENGTH

For wool fibers there are two measures of length, staple (lock) length and fiber length. Fiber length is the characteristic or average length of the individual fibers. Staple length is the characteristic length of a bundle or tuft of fibers. The fiber length for raw wool has a different significance than for cotton. A significant percentage of wool fibers break during scouring and combing and, consequently, the length of the raw wool fibers does not adequately correlate with the length of fibers in wool top (after scouring and combing). The measurement of raw wool fiber length is tedious and time consuming and usually is only attempted in special or research projects.

Staple length can be measured while the fleece is on the sheep or after clipping. The usual instrument for making the measurement is a six-inch rule. The primary value of a measurement of staple length is to predict the amount of wool a particular animal will yield. The longer the staple, the greater the amount of wool per animal. To measure staple length, several tufts of fibers are withdrawn from the fleece. The tufts are then lined up on the cut end. A rule can be used to measure the characteristic length of the unstretched staple. Unstretched staple length has a high correlation with the average length of fibers in wool top. Experienced wool classers can estimate staple length without the direct use of a rule. Also, a machine, the Almeter, has been developed to measure staple length semi-automatically. The tufts of fibers are placed on a conveyor belt that passes through a light beam which senses the length of the tuft.

For marketing purposes, wool is sampled using a core sampler. It is not possible to perform reliable length measurements on the fibers sampled using a core sampler because the sampling procedure cuts the fibers. For research purposes, or other circumstances where it is necessary to obtain a blended sample

from a bag, a hooked-needle probe can be used to pull small tufts of fibers from the bag.

The Australians have indicated an intention to include staple length as one of the market value measurement they will supply to wool buyers. Whether wool buyers can effectively utilize this data has not yet been determined, but the test program to be conducted by the Australians should be monitored.

The length of wool fibers in top is a very important property of the top. Textile manufacturers routinely perform fiber length measurements on top. The processability of the yarn and fabric that will be produced are greatly influenced by the fiber length characteristics of the top.

COTTON FIBER STRENGTH

A number of different strength-related properties of fibers can be measured that are of importance in determining performance in certain products or processing conditions. These strength properties include breaking strength, modulus, work of rupture, and many other forces applied in fibers and yarns resulting in tension, bending, torsion, and shear. The values of these properties for cotton vary greatly depending upon the gauge length, rate of loading, the testing procedure, and atmospheric conditions surrounding the fiber.

Cotton fiber tensile breaking-strength is of importance in textile manufacturing for certain products and processing conditions. Two commonly used laboratory instruments for measuring fiber strength are the Pressley Tester and the Stelometer. Strength measurements using these instruments are fairly time-consuming and too costly to be widely used for marketing and mix control in textile mills.

The HVI measurement system includes an instrument that makes a rapid, low-cost measurement of fiber bundle breaking strength. Indications are that the availability of this information will be a valuable addition to the market value properties provided by the supplier. At the present time only the fiber bundle breaking strength is recorded as part of the system. However, the instruments used in the HVI system digitize the signals from the sensors and include computers to analyze these signals. A fairly low-cost reprogramming of the system would allow the determination of other tensile properties such as modulus, work of rupture, elongation, and others. Several Workshop participants recommended that research studies be conducted to determine the usefulness of some of these newly available measurements in controlling quality characteristics of yarn and fabrics or as an indicator of fiber processability.

WOOL FIBER STRENGTH

The average strength of wool fibers is generally not an important market value parameter. However, an important market value characteristic is the existence of weak spots along the length of the fiber. When stresses are placed upon the animal, a weak spot may form in the fiber because of poor wool growth during the stress period. As the wool grows out, this weak spot may exist in most of the fibers in the fleece at a similar relative position along the fiber length. If all of the sheep in an area are subjected to the same stress period, as would be the case of stress caused by adverse climatic conditions, the weak spot at a specified length along the wool may be characteristic of most of the wool from the area.

The wool appraiser evaluates the wool fiber strength of raw wool by grasping both ends of a tuft of fiber and pulling until the tuft breaks. He looks at the break to see if the fibers in the bundle all broke at the same length or whether the fiber break points are distributed throughout the fiber's lengths. If the fibers all break at the same point, this indicates a weak point (called a break) and the market value of the wool is reduced because of the weak point. The location of the weak point along the length is also important as many of the fibers will break at the weak point during scouring and combing. The fiber length distribution in combed wool is thus related to the location of weak points along the fiber. Weak points near the ends of the fiber which result in many very short fibers can be a particular disadvantage for fibers processed on the worsted yarn system.

The capability of a wool classer to sense wool fiber strength has been studied. It has been found that a wool classer will typically grade wool to be of average overall strength when the actual strength is within the range from the highest strength to about 17 to 30 percent of the highest strength.

Only when the fibers are weaker than this will the classer generally downgrade the fibers for lack of adequate strength. In wool fibers, a bundle of fine fibers is weaker than an equal mass bundle of coarser fibers, a relationship opposite to that for cotton.

Australian researchers have determined that strength is a market value property they plan to include in their marketing information in the near future. They have developed a semi-automatic staple strength tester. The tester grabs the staple (lock) at the ends and breaks the staple, thus measuring the required breaking force. They report that fiber strength is quite variable throughout a wool lot and that in order to obtain a reliable estimate of fiber strength it is necessary to examine about 50 samples rather than the three or four samples usually selected for examination by the wool buyer.

COTTON FINENESS AND MATURITY

Fineness and maturity are two important properties of cotton that are related to fiber diameter. Fineness is the average diameter of the fibers in a sample. Fineness is important in textile processing because it is related to the processing efficiency and size (linear density) of the yarn produced. Maturity is wall thickness development of the fibers. The average cross sectional perimeter of cotton fibers of a particular variety grown under similar conditions is about the same. As the fiber matures during growing, the wall of the fiber becomes thicker and the fiber shape changes from ribbon-like to cylindrical. Maturity is important in textile processing as it is related to the formation of neps and to dyeability.

The measurement of fiber fineness is presently included as part of the USDA traditional grade-staple cotton classing system and the HVI system. Most textile manufacturers make use of this property in forming a mix of fibers for producing a specific product and, to some extent, in buying cotton. Representatives of textile manufacturing companies participating in the Workshop reported that their companies make micronaire determinations for each bale, duplicating the data provided by the supplier. The reason for duplicating the data appears to be a lack of confidence in its reliability and a belief that it is very important to consider fineness in selecting bales to form a product mix.

The micronaire device used for measuring fineness is an airflow instrument. A specified weight of fiber is placed into a small chamber, compressed to a standard volume, and air is forced through the fibers. The finer the fibers the greater the surface area and the greater the pressure drop through the fibers at a specific airflow rate.

The measurement of fineness is one of the more labor-intensive functions of the HVI system. Research has been conducted to develop an improved instrument procedure. Optical scanning devices can be used to measure average fiber fineness and also to provide information on fiber fineness distribution or variability in a sample of fibers. Research has indicated that several fiber shape factors can be measured rapidly using optical scanning computer analysis methods. However, further research and development is necessary in order to make this procedure practical for routine testing. A method for preparing, holding, and viewing the fibers needs development.

One reason micronaire readings are widely used in textile manufacturing is that they can sometimes be used as an indication of fiber maturity. For a particular variety of cotton, the perimeter of all the fibers tends to be nearly the same. The average diameter of the fibers is thus related to the wall thickness. Micronaire measurements of fiber fineness may therefore be used to assess the relative fiber maturity of a lot of the same variety of cotton. Textile manufacturers buying cotton directly from farmers or farmer cooperatives generally know the variety of cotton being purchased. Some Workshop participants suggested that USDA include the variety as part of the USDA classification. It was observed that changes in the way the system is structured would be necessary if USDA reported variety data because there is no way to verify variety information provided by the supplier of the sample of cotton submitted for classification. It was observed that perhaps the USDA testing program could provide data concerning fiber perimeter or fiber cross-section. There is a need for research to develop a fast and low-cost measurement procedure for assessing fiber shape.

Several similar but slightly different methods commonly used to measure cotton fiber maturity include Causticaire maturity, NaOH maturity, Fiber

Maturity Tester (FMT) maturity, and others. Although these methods do provide a measure of fiber maturity, all require time-consuming procedures. None of the methods is suitable for inclusion in an automated testing line such as the HVI system.

Research is currently underway to determine whether an infra-red colorimeter may be used to obtain an indication of fiber maturity. A special infra-red colorimeter has been developed and is used to measure properties of grains. The instrument is termed the Grain Quality Analyzer (GQA). Cottons of various maturities have been analyzed using this instrument and it has been found that there is a close relationship between the infra-red reflectance spectrum of the fibers and their maturity. Further research is necessary to determine the precision and reliability of this technique. The technique has the advantage of being a measurement procedure that could be electronically automated to provide the rapid, low-cost measurements required for an HVI system.

WOOL FIBER FINENESS

Fiber fineness is the most important market value property of wool. Fiber fineness accounts for about 80 percent of the value of the fiber.

In the United States, the accepted standard method for evaluating wool fiber diameter is by microprojection. Wool fibers are magnified 500 times and the diameters of 400 to 2,600 fibers are measured. Although this method is the standard procedure used for determining market value, and in textile manufacturing for selecting wool for a fiber mix, the method has many major deficiencies. It is very time-consuming and costly. It is difficult to evaluate as many fibers as should be measured in order to characterize a lot of wool. Research has been underway for many years and there is a continuing need for further efforts to develop a faster, automated method for obtaining the average value of wool fiber fineness. Research has been and should be conducted to improve current microprojection techniques and to develop an improved measurement method or instrument.

One of the problems with the presently used microprojection measurement technique relates to presenting the fibers for microprojection. Present procedures are time-consuming, manual operations that can be easily influenced by operator technique. There is a need to develop automated or rapid methods for preparing the sample and presenting it for projection. Another potentially promising research area is the adaption of digitizers and optical scanners into an instrument using the microprojection technique to develop a faster, automated method for measuring projected diameter.

A number of alternate wool fiber fineness methods and instruments have been proposed or are currently used to a limited extent. Some are:

Port-Ar (Spinlab Instruments)

Micronaire (Sheffield Corporation)

WIRA Fiber Fineness Meter (WIRA)

Sonic Fineness Tester Model A (CSIRO)

PiMC Electronic Image Analyzer (Millipore)

Ladd Image Analyzer (Ladd Research)

Coulter Counter (O'Connell and Harsh report)

Liquid Scintillation Spectrometer (CSIRO)

Fiber Diameter Analyzer (Leeds)

Mikronmeter (South Africa)

Of these techniques or instruments, the principal ones used in the United States are Wira and Port-Ar. All of the techniques need further development or research for the results to be more directly comparable to the microprojection method. Also, there is a need for research to correlate the data produced by these various measurement methods with the true market value of wool fibers as determined by their performance in textile manufacturing.

COTTON REFLECTANCE MEASUREMENT

The light reflectance of cotton fibers may be measured for the visible range, ultra-violet range, and infra-red range. Light reflectance in the visible range is routinely evaluated for measurement of color.

The color of cotton fibers has traditionally been accepted as an indicator of market value because the color of the fiber may be important in the manufacture of certain textile products and because color may be an indicator of the values of other fiber properties. The color of cotton fibers is considered by the cotton classer in determining grade in the traditional grade-staple system. Color of fibers can be measured rapidly using instruments and a color measuring instrument is included as part of the HVI measurement system.

The color of an object is typically described using three coordinates or tri-stimulus values. These coordinates typically represent the three ranges of color: black to white, blue to yellow, and green to red.

One widely used instrument for measuring color is the Nickerson-Hunter Colorimeter. A number of years ago, Dorothy Nickerson showed that tri-stimulus values are highly related to the color of different standard grades of United States cottons. A relative scale was developed that described the usual or normal values of the tri-stimulus coordinates for each grade of cotton. Since cotton tends not to be red or green, only the values of the two coordinates, black-white and blue-yellow,are required to characterize the color. The relative grayness is measured along the black-white coordinate and the relative yellowness along the blue-yellow coordinate. The tri-stimulus values of cotton fibers may be measured using a colorimeter or other color measurement

device and the values of the tri-stimulus coordinates of the sample compared with the relative scale values for various cotton grades. The grade classification of the sample is made by other means and the color values may be evaluated to determine whether the color of the sample is the accepted color for that particular grade. A particular sample is typically designated as being White, Spotted, or Tinged. A White designation indicates a similar grayness and yellowness to the standard for the grade; Spotted indicates more gray and more yellow than the standard; and Tinged even more gray and more yellow than Spotted.

Instruments that will make rapid low-cost measurements of the tri-stimulus values of the color of cotton fiber samples are generally available or could be developed based on existing technology. Except for the influence of trash on the color measurement, the problems associated with assigning market values to the levels of fiber color are not related to the measurement of the property but rather to interpreting the relationship between color and market value. Research and textile mill practice has shown relationships among color and waste, ends down, yarn quality, dyeing and bleaching problems, yarn color, and other important market value characteristics. However, the relationships among these characteristics and fiber color are not well defined. Workshop participants representing the textile industry indicated that for certain products fiber color must be measured and considered in forming a product mix in order to achieve uniform color of the dyed product. Some cotton users also utilize color measurements to indicate fungal or bacterial damage from weathering. Several Workshop participants observed that there may be a need for additional research to determine how measurements of color may be more effectively utilized to indicate market value. The cost of including color

measurements as part of the HVI system is quite low, but the cost-effectiveness of the data has not yet been firmly established.

Another reflectance property is the reflectance in the ultra-violet spectrum range. A commercial instrument is available for measuring the ultra-violet reflectance characteristics of cotton fibers, and technology is available to allow the design of instruments to provide low cost UV measurements as part of HVI Systems. Several Workshop participants questioned whether data on ultra-violet reflectance could be effectively interpreted as a market value property. A measurement of the ultra-violet spectrum results in an evaluation of the fluorescence of the fibers. Several Workshop participants representing the textile manufacturing industry indicated they have found it necessary to evaluate the fluorescence of cotton in forming a mix for certain products. Bale samples showing extreme fluorescence must be identified and separated in order to achieve adequate color control in the final dyed textile product.

Another reflectance property of interest is in the infra-red spectrum range. Reflectance values in the infra-red spectrum do not appear to be important with regard to color control. However, several researchers have found that measurements of infra-red spectrum reflectance provides useful information in predicting certain other market value properties. Some research was reported indicating measurements of the infra-red spectrum may be useful in predicting the yellowness and grayness of fiber samples. Measurements may also be useful in assessing the trash or non-lint content. There is need for further research to determine whether measurements of the infra-red spectrum may be useful for indirect assessment of trash content or characterization of the trash. Other research has indicated a relationship between infra-red spectrum characteristics and the sugar content of cotton. The presence of

sugars on the fiber surface can greatly affect processability and extremes in sugar content are, therefore, an important market value characteristic. There is need for further research to determine whether infra-red spectrum measurements can be used to reliably assess sugar content.

WOOL REFLECTANCE MEASUREMENT

There are no accepted standards for the color of raw wool fiber. The color of wool fibers is an important property in the manufacture of certain textile products, but industry dyers do not agree on what constitutes an acceptable range for color differences.

Considerable research has been conducted in recent years on the use of infra-red reflectance to estimate various market value properties of wool fibers. Researchers have developed, using empirical methods, relationships between the reflectance at various infra-red frequencies and yield. A correlation of 0.91 has been found between actual and predicted values of yield in scoured wool cores. Several instruments are available that can be used to make infra-red reflectance measurements. These instruments have not been developed specifically for use with wool but adapt fairly well for use on wool. They range from fairly inexpensive colorimeters, utilizing filters to make measurements at a few selected discrete frequencies, to quite expensive infra-red spectrometers.

Workshop participants recommended that research be conducted to further develop relationships between infra-red reflectance properties and market value properties of wool. There are some indications that there may be correlations between infra-red reflectance and properties such as fineness, residual vegetable matter, and other important market value properties. Infra-red reflectance measurements indirectly relate to these properties and thus may not provide an absolutely reliable measure. However, the potential advantage of making rapid-low-cost measurements to predict difficult-to-measure properties is worthy of further investigation.

COTTON YIELD, TRASH AND CONTAMINANTS

The fiber yield from a bale of cotton is inversely proportional to the trash or non-lint content. Trash content is a major factor considered by the cotton classer in determining the grade.

The higher the grade the lower the non-lint content. The average percent non-lint content for a high grade, "Strict Middling", is 1.9 percent and for a low grade, "Good Ordinary", is 7.2 percent.

The cotton classer determines grade by subjectively assessing trash content, color, and texture through comparison of samples of cotton to be graded with standard samples prepared by USDA. A cotton classer can assess grade quite rapidly and with considerable precision. Experience has shown that when a sample of cotton is classed a second time, a classer will usually assign the same grade designation as the first time. The repeat grade designation is higher or lower by one grade 26 percent of the time.

The non-lint content can be measured objectively by an instrument called the Shirley Analyzer. This instrument processes a sample of cotton in a manner similar to the processing performed during textile yarn manufacture. The sample weighed before and after running it through the Shirley Analyzer, and the non-lint content is the weight loss during processing. The Shirley Analyzer measures non-lint content quite reliably, but has the disadvantage of requiring a fairly large sample and several minutes of operator time. Smaller, faster instruments working on the same principle of mechanical separation of lint from trash have been developed over the years but none has been fast enough or economical enough for use in the HVI system.

In the present HVI system, the trash content is determined by human assessment of the sample. The sample is compared with pictures of standard samples representing various amounts of trash. The level of trash in the sample is designated by selection of the picture which best corresponds to the sample. This technique has the disadvantage of relying on the subjective decision of the technician. An automated instrument for measuring trash content as part of the HVI line is needed.

Limited research has been conducted on the development of an instrument for measuring the trash content by electronically analyzing the reflected light pattern from the surface of a cotton sample. This technique shows promise as a basis for an instrument for the HVI line and further research is recommended to develop the technique and a cost effective instrument.

The market value of cotton is influenced by the specific type of trash as well as the amount of trash. A cotton classer traditionally takes into consideration the type of trash when classing cotton. Some preliminary research has shown that the infra-red spectrums of different types of trash such as leaf, stem, bark, etc., are significantly different. An optical scanning device that analyzes the surface reflections patterns in the visible and infra-red color spectrums might be able to differentiate between different types of trash. Further research on this technique is recommended.

Another factor, in addition to trash, which influences the yield of useful fibers in a sample is the percent of short fiber in the sample. Very short fibers or fiber fragments are separated out during textile processing and have little value in yarn production. They also cause "fly" in the mill atmosphere which is a major disadvantage, influencing both quality and production

rate. The short fibers lost during yarn manufacturing may be short fibers that were in the samples of raw cotton or may be fiber fragments generated by fibers breaking during processing. There is a need for further research to examine the influence of short fibers on the use value of cotton. If the amount of short fiber is determined to be an important market value property, there is a need for research to develop an instrument for measurement of this property. One instrument approach that has been suggested involves measurement of the fiber length and length uniformity before and after some type of processing of the sample to determine the amount of short fiber generated during processing.

Another factor influencing the yield of useful fibers in a sample is the amount of fiber loss during wet processing. It has been found that samples of low micronaire cotton lose as much as 9.4 percent by weight during wet processing and high micronaire cotton as much as 5.5 percent. Other factors in addition to micronaire also relate to the fiber loss during wet processing. The amount of fiber loss is significant and results in a direct economic loss to the user.

Certain contaminants on the surface of cotton fibers may influence their market value. One common contaminant is oil from picker spindle lubricants or processing machinery. The level of oil on the surface of cotton fibers can greatly affect processing. There is a need for research to establish the market value influence of various levels of oil. There is also a need for research to develop an instrument or technique for measuring surface oil.

Sugar from residual plant substances and aphid residues is another fiber surface contaminant. A high sugar content may cause the fibers to stick during textile processing and greatly influence processability. Sugar content has been found to be influenced by variety,

geographic area of growth, maturity, and other factors. A small amount of sugar does not influence processability, but when the amount of sugar exceeds a certain level, processing can be difficult on modern high-speed textile machines. Surface sugar seems to be a greater problem when cotton is processed shortly after ginning than when cotton is stored for many months. Localized spots of high sugar can be a greater problem than a high average sugar level. There is a need for further research to evaluate the level of sugar as it relates to processability and to develop an instrument for rapid and low-cost measurement of excessive sugar.

Another cotton contaminant is dust. Cotton dust control during textile processing can be very expensive. Some cottons generate more dust during processing than others. The market value of low levels of dust in cotton is not known. There is a need for further study to determine the values textile mills will place on particular levels of dust in cotton as these mills implement dust control technology. If the level of dust in cotton is a property with market value, there is a need for development of an instrument to measure this property. Dust in cotton may also be important in determining spinning performance for open-end spinning. Further research is needed to determine the relationships.

WOOL YIELD AND CONTAMINATION

A high percentage of the content of bales or bags of raw wool is not wool fibers but grease or oil from the animal. The yield of wool fibers from the bale or bag has long been considered an important market value property. The U.S. Customs Service measures the yield of most of the wool imported into this country. Workshop participants representing textile mills indicated that they accept and utilize the data provided by the U.S. Customs Service as a basis for establishing prices for the wool they buy. When the U.S. Customs yield data is not available, as is the case for domestic wool, the textile mill typically has a commercial laboratory test each lot of wool for yield.

Yield for wool is determined by weighing a batch of core samples taken from a lot of wool before and after scouring. Approximately 15 minutes is required to scour the wool and then the sample must be dried and weighed. This measurement procedure is quite slow and costly. There is a need for research to develop a more rapid, less costly method for establishing yield.

The vegetable matter content is also an important market value property of wool. Wool is often bought with the requirement that the vegetable matter be below a specified level. The U.S. Customs Service laboratory and commercial testing laboratories test wool core samples for vegetable matter. As in testing for yield, the procedure is quite slow and expensive. The market value of wool fiber with various levels of vegetable matter has not been well defined. The presence of vegetable matter such as cockle burs or spiral burs is of a particular importance. A few of these burs can adversely affect the performance of certain textile machines that cannot handle them because of

their shape. No instrument procedure has been developed to reliably detect their presence.

Contaminants found in wool, in addition to vegetable matter, include sand, lime, polypropylene bagging, cotton, and many others. Excessive amounts of these contaminants can greatly influence the market value of wool. No instrumental techniques have yet been developed to measure them. They are traditionally measured subjectively.

An important natural contaminant wool is black fiber, which is normally associated with the black face breeds of sheep. A small number of black wool fibers can influence the market value of a lot of wool. No instrumental procedure is available for detecting or measuring the presence of black fibers.

OTHER PROPERTIES AND OBSERVATIONS

There are a number of fiber properties in addition to those discussed in previous sections of this report that may be important in determining the market value of cotton or wool. Many characteristics of fiber that greatly influence textile processability are not measured today. Important not-yet-measured characteristics include potential for nep formation, fiber surface properties, cohesive friction, and others. There is need for further research to determine the relationships between these characteristics and the market value of the fibers and to develop methods for their measurement.

If the fiber producer had available measurements of the fiber characteristics that are of importance in determining the true value of fiber, he could and would direct his efforts toward the production of fiber of greater true value. At present, many characteristics that are important in textile manufacturing are assessed by the textile mill, but the values of these characteristics are not communicated to the fiber producer in a manner that allows him to systematically enhance his product quality. At present, some farmers believe that instrumental measurement of a range of fiber characteristics is a scheme to identify factors that can be used to discount the value of their crop rather than an improved assessment of its true value.

Workshop participants representing textile mills unanimously and emphatically indicated that they do not have sufficient confidence in the USDA fiber test data provided by the supplier to presently accept the data without verification of their own. The reasons for this lack of confidence in reliability of the data are not clear. The lack of confidence in the data may be

because the HVI system has not been in operation long enough to establish confidence. Micronaire data has been provided by USDA for many years and is available from the fiber supplier, yet textile mills believe they must re-measure this property themselves in order to select bales of cotton for product mixes where micronaire is important. Their experience has led them to believe that the number of bales with incorrect data is too high for confident bale selection for a product mix. The level of reliability required for selection of bales for processing is much greater than the level of reliability required for establishing a fair market price for a lot of cotton.

One reason for the lack of confidence in USDA measured data provided by the fiber supplier is a lack of confidence in the reliability of the bale identification number. Bale identification numbers occasionally become lost or are changed. Another reason for the lack of confidence in USDA measured data is the attitude that "we always trust our own measurements more than those of others." Since textile mill laboratories use the same instruments and procedures as USDA and employ similarly trained laboratory technicians, there may not be a valid reason to expect their own data to be more reliable than that from USDA laboratories.

Workshop participants recommended that some effort be directed toward improving the reliability of bale identity. Some suggest that bale identification rules and procedures should be changed so that a bale would not lose its old identity if its owner decides to renumber and submit a new sample for classing. Participants also strongly recommend that USDA make more extensive use of computer-based data handling systems to make it easier for textile mills to obtain and assimilate all available data on the bales they intend to use in processing.

Textile mills are not currently using all of the data that is available to them. For instance, instrumentally measured properties such as uniformity ratio and color are often available both from the fiber supplier and the textile mill laboratory measurements. Although available and recognized as important, the data is often not utilized. There is a need for research to develop improved and more useful relationships between textile fiber processing and the fiber property measurement data that is, or could be, made available to the textile manufacturer.

Many Workshop participants representing textile mills indicated that they presently do not, or in the near future will not, utilize some of the data measured by the HVI system. Workshop participants could not agree on any measurements that should be dropped from the system. For each measurement in the system, there were some Workshop participants who used the data and believed it was of value to them, even though some other participants were not using the data.

There obviously is still a large communication gap between the fiber producer and the textile mill concerning the value of certain fiber properties. This communication gap appears to be much greater for cotton and wool than it is for synthetic fibers. There is a need for continued research to develop relationships between measurable fiber properties and fiber performance. There is also a need for research to develop more reliable and less costly measurement techniques for important properties that cannot now be measured.

NATURAL FIBER PROPERTIES WORKSHOP
Charlotte, North Carolina
March 11-13, 1981

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A G E N D A

NATURAL FIBER PROPERTIES WORKSHOP
Charlotte, North Carolina
March 11-13, 1981

Wednesday, March 11

1:30 PM	Orientation and Objective Identification - - - -	Nelson Getchell
1:45	Current and future needs for fiber property measurements for marketing and utilization of natural fibers - - - - - - - - - - - - - - - - - - -	Jesse Moore
2:15	Cotton Sampling - - - - - - - - - - - - - - - - - - -	Andy Jordan
3:15	Break	
3:30	Wool Sampling - - - - - - - - - - - - - - - - - - -	Charles Huff
5:00-7:00	Informal Discussions	

Thursday, March 12

8:00 AM	Length and Length Uniformity - - - - - - - - - - -	Preston Sasser James Bassett
9:50	Break	
10:10	Strength and Mass Measurement - - - - - - - - - -	Hassan Behery Richard O'Connell
12:00 N	Lunch	
1:00 PM	Fineness and Maturity - - - - - - - - - - - - - - -	Harmon Ramey Keith Padgett
2:50	Break	
3:10	Reflectance Measurements, Color, UV, IR, etc.- -	Harvin Smith Svend Larsen
5:00-7:00	Informal Discussions	

Friday, March 13

8:00 AM	Yield, Trash, and other Contaminants - - - - - -	Henry Perkins Charles Huff
9:50	Break	
10:10	Other Fiber Properties - - - - - - - - - - - - - - -	Kenneth Bragg Keith Padgett
12:00 N	Summary -	Ivan Kirk
1:00 PM	Adjourn	

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